WICHITA CENTRAL CORRIDOR RAILROAD GRADE SEPARATION

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Abstract:

Wichita, Kansas, is the 51st largest city in the Unites States, and has numerous at-grade railroad crossings through the core of the City. The City sought to reduce traffic congestion and the potential for accidents by separating some of the key crossings along two miles of its north-south Central Rail Corridor. Elevating the tracks while maintaining both rail and street traffic would involve extensive coordination with the Union Pacific, BNSF, and two short line railroads. The City retained TranSystems to provide program and construction management services on the $105 million project.

New railroad bridges were built over five arterial streets. All of the grade separation structures now carry two new main railroad tracks with room for a third track. Overall, eight miles of track were constructed, and five existing at-grade street crossings were permanently closed.

The 13-year effort included four years of construction that was completed in September 2009. The result was a reduction in traffic congestion and train noise, with associated improvements in safety and quality of life for Wichita residents, and operational improvements for the railroads. This landmark project now serves as a model for similar projects across the nation.

Session topics include:

- Funding and contracts
- Structures: Foundations, bridges, retaining walls, and tracks
- Communications and Signals – Centralized Traffic Control system
- Construction Sequencing – maintaining rail and street traffic during construction
- Partnering during construction – teamwork and communication at the forefront
- Safety
- Environmental considerations
- Lessons learned
- Questions and answers

INTRODUCTION

1887 Wichita on the Chisholm Trail

Dating back to the late 1800s, the city of Wichita shared a mutually beneficial relationship with the railroads – the railroads provided a low cost option for transporting goods and people to and from distant markets. The City's population grew at a rapid pace and the Central Rail Corridor was at the center of it all. Even at a time before the first automobile traversed the land, the infrastructure was overwhelmed. Horse-drawn wagons, bicycles, and pedestrians clogged the downtown streets causing serious train accidents and delays.

In the early 1900s, the first solution was constructed at a cost of $3 million for a new railroad depot and train bridges over three downtown streets. However, this initial solution could not predict the burgeoning population, expanding rail traffic, or the increase in sheer size and number of vehicles that would occupy the roadway by the end of the century.

Today, Wichita is the most populous city in Kansas, the 51st largest city in the US, and an important hub for rail trade. Tracks referred to as the Central Rail Corridor bisect the downtown area and create numerous at-grade railroad crossings that lead to increased traffic congestion. Wichita's Central Rail Corridor carries more than 40 trains per day, and this number is expected to double in the future.

Issues continued to develop with the trains passing at street level – train whistles were blaring and drivers were experiencing as much as a 30-minute delay with each passing train. Accidents had become an increasing issue. Large trucks were falling victim to inadequate vertical clearance, colliding with bridges having vertical clearances of only 13, 12, and 10 feet, and threatening the two main railroad tracks above. These narrow bridges became an impediment to commerce, restricting the number of traffic and pedestrian lanes that could pass beneath them. A major hospital had developed adjacent to one of the major at-grade crossings, and the mobility of ambulances and other emergency vehicles was seriously restricted.

To improve safety and reduce traffic congestion and the need for train whistles, the City took the lead in separating some of the key crossings. This work would involve extensive coordination with the Union Pacific Railroad (UPRR) and Burlington Northern Santa Fe Railway (BNSF) Class 1 railway companies, as well as two short line railroads. And of course the sheer cost seemed out of reach.

FUNDING AND CONTRACTS

The Perfect Storm

In 1996, the federal Surface Transportation Board (STB) approved the merger of the Union Pacific and Southern Pacific Railroads, thus doubling the number and lengths of trains that would be passing through Wichita. This caused a crushing need for traffic and safety improvements, and plans for a major grade separation structure in the heart of Wichita began to emerge.

Also in the late 1990s funding started to become available through the Kansas Department of Transportation's (KDOT's) Comprehensive Transportation Plan (CTP), and there were programs to improve or eliminate at-grade crossings funded through the Federal Highway Administration (FHWA) and the Federal Railroad Administration (FRA). The city applied for, and received funding for the Wichita Central Corridor Railroad Grade Separation Project.

Project Development – Setting the Stage and Building a Team

Nine years were spent in the Project Development phase. The City retained the services of TranSystems to provide program and construction management for the $105 million project, and HNTB as the designer-of-record. The new design involved the elevation of a two-mile section of track, new railroad bridges at three streets, replacement of two low clearance bridges with much larger structures, and the widening of one historic bridge. The elevated grade separation structure would carry two new main tracks with room for a third track. Overall, eight miles of track would be constructed within the confines of the project and five existing at-grade street crossings would be permanently closed.

The completed Wichita Central Corridor Railroad Grade Separation bisects the aerial view above diagonally.

A formal public involvement process was implemented so information could be presented and received by the City and its design team. A number of formal agreements were written between the City and local businesses that would be directly impacted by the project. Agreements were also developed between the City and its funding sources, including KDOT, FHWA, and Union Pacific Railroad. An agreement was reached with BNSF for use of its right-of-way, and an agreement for the final project design was executed.

Memoranda of Understanding were developed between the City and the Railroads. Significant portions of the project would be designed and constructed by the railroads themselves, and the terms were outlined in Construction and Maintenance agreements. This required Authorizations for Expenditure (AFEs) whereby the railroads would be compensated for their work from project funds.

Final construction plans were completed and coordinated by the City and the railroads. Final construction documents were developed for the portion of the work to be contracted by the City, and that part of the work was let out for bidding. Dondlinger and Sons Construction Company was the successful bidder, and they developed more than 20 subcontracts and agreements with fabricators and material suppliers. Dondlinger also developed a detailed computer based critical path project schedule, as required by the project Specifications.

STRUCTURES: FOUNDATIONS, BRIDGES, RETAINING WALLS, AND TRACKS

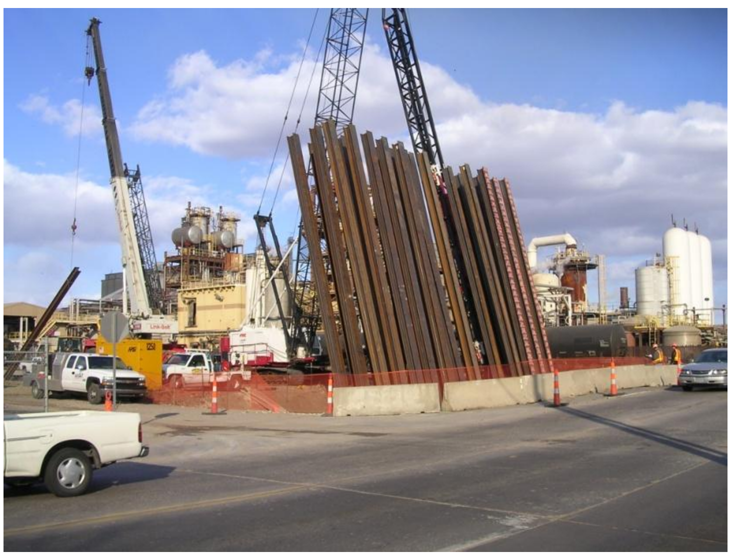
Scope of the Construction

This landmark project, the Wichita Central Corridor Railroad Grade Separation, raised two miles of track and provided five new bridges to carry trains over arterial streets below. Between the bridges, the tracks are elevated on a 25-ft. embankment supported on the east and west sides by a precast concrete retaining wall system. The five arterials were rebuilt at lower elevations to provide the necessary 15 ft., 6-in. vertical clearance. The retaining walls allowed the project to be built almost entirely within the existing right-of-way.

One of the initial challenges of the project was construction of a Temporary Main Track to carry trains from two existing main tracks, 2.5 miles around the construction site. It was built on existing right-of way such that all cross street traffic was maintained, along with full service to all local rail customers during construction.

Train operating on temporary main track.

Five new train bridges spanning up to 85 feet were constructed over arterial streets, plus one bridge widening to accommodate two new main tracks and room for a third. The bridges are simple span steel girder structures supported on 700 steel H-piles driven 80 feet into a shale layer below. Pile acceptance parameters were established using Dynamic Pile Testing on representative test piles. The 50-ton steel girders were delivered by rail from Oregon, and off loaded by massive cranes from the Temporary Main Track during short time windows to minimize disruption of vehicular and train traffic.

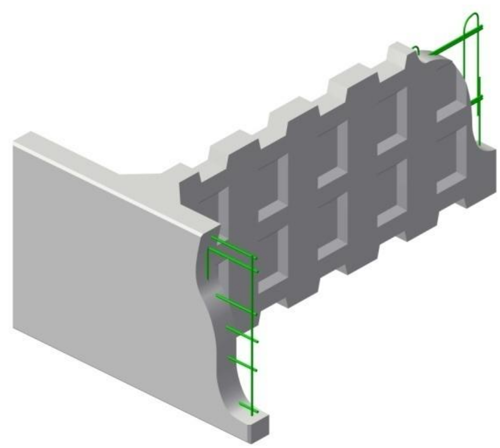


Battered bridge abutment piles.

Minimizing impacts to the public in the urban project setting presented a host of challenges. City leaders were concerned about the impact of construction on the surrounding residential and commercial area as the project site was located right in the heart of Wichita. Building precondition surveys were conducted prior to construction, and pile-driving operations were scheduled to minimize the public impact. Vibration monitoring was performed during pile driving and other aggressive construction operations to identify

problem areas and protect the City from claims. Erecting the bridge girders required complete street closures, and all such operations were conducted on early Saturday mornings to minimize disruption.
In order to support the embankment and three main tracks between the bridges, the loamy clay sub-grade had to be stabilized. Seven thousand-five hundred 30-inch diameter rammed stone piers were constructed by augering 10 to 30 feet deep into an underlying sand layer, and load tested to ensure they met design requirements.

The system was designed to support Cooper E-80 loading from the main tracks and contain 50,000 semi-truck loads of locally available fill material. The proprietary wall system is a variation of a gravity wall system with redundant safety features. There are no exposed metal components or connections buried within the embankment. The T-shaped reinforced precast concrete units predominantly had face dimensions of 7.5 feet x 5 feet, with 5-foot-tall stems extending back into the embankment 10 to 20 feet. Some 7,800 units weighing up to five tons each were fabricated and stockpiled at a nearby plant, along with 1,100 parapet wall units, totaling 320,000 square feet of wall face.



Proprietary precast retaining wall unit.

Once the specified settling period for the walls and ground improvement system was completed, precast parapet walls were placed atop the retaining walls, and a horizontal moment slab was constructed of reinforced cast-in-place concrete. The surface of the granular fill was stabilized using salvaged railroad ballast and sealed with asphalt sub-ballast. Surface drainage is captured in deck drains, and runoff is piped downward, exiting the face of the wall where energy is dissipated on rip rap.

The two new main tracks were constructed of new 136-lb. continuous welded rail (CWR) on wood ties, and fully de-stressed and tested in accordance with BNSF standards. Service tracks were constructed at ground level using 112-lb. and 115-lb. rail that had been salvaged during Phase 1 of the project. The track changes necessitated signal modifications by the railroads, and introduced opportunities for upgrades, including a new Centralized Traffic Control System improving track safety.

Overcoming Challenges

All utility lines passing beneath the construction were either relocated or encased to satisfy the current BNSF Utility Accommodation Policy. Complicating all of the subsurface work was the presence of near surface ground water contamination that triggered regulatory requirements and posed potential risks for workers.

CONSTRUCTION SEQUENCING

Maintaining Rail and Street Traffic During Construction

The Project Team was tasked with accomplishing the full project scope safely, while maintaining service for the railroads and their customers. Plus, provisions had to be made for 80,000 vehicles passing through the project each day, and ADA compliant pedestrian traffic facilities. This required an intricate sequencing plan with sequential street closures, allowing no two adjacent arterial streets to be closed at the same time. Separate working day time periods were established for each of the five arterial roadways to limit the impacts to vehicular traffic.

A Phased Approach

Phase 1: The temporary main track was constructed, and train traffic from the two existing main tracks was diverted onto it. This was preceded by the necessary removal of existing structures, utility relocations, ground improvement, subgrade improvements using crushed concrete and geogrid, sub-ballast construction, and drainage modifications.

Phase 2: The two old main tracks were salvaged and stockpiled, along with existing ballast, salvageable ties, and other track materials (OTM). Ground improvement and utility adjustments resumed in the area of the future grade separation structures. The western two thirds of the new bridges, west retaining wall, and embankment were constructed, and the New Main Track 1 was constructed atop the new grade separation structures. Much of the train traffic was diverted up onto New Main Track 1, and out of the street traffic below, allowing release of traffic beneath the bridges.

Ballast delivery

Phase 3: A portion of the east retaining wall was constructed, along with track necessary to shift the remainder of the main track traffic up onto the grade separation structure, thus allowing construction of the ground level industry tracks.

Phase 4:   The eastern portions of the bridges were completed, along with the remainder of the east retaining wall and embankment, and New Mainline 2 was constructed atop the new grade separation structures. The streets below were sequentially removed and reconstructed at lower elevations to provide the minimum bridge clearance, requiring additional utility adjustments and storm drainage improvements. All landscaping, irrigation, lighting, and punchlist items were completed for final acceptance, and the project was completed in 2009.

PARTNERING DURING CONSTRUCTION – TEAMWORK AND COMMUNICATION AT THE FOREFRONT

Constant communication was necessary between the City of Wichita, Kansas Department of Transportation (KDOT), Federal Highway Administration (FHWA), Federal Railroad Administration (FRA), UP, BNSF, and the construction team. To enhance communication and keep the project moving forward safely and on schedule, a number of documentation and reporting tactics were employed. The intricate and interconnected network of stakeholder contracts written during the Project Development Phase laid the ground work for executing the project over a four-and-a-half-year construction period, plus the maintenance period beyond.

During weekly progress meetings, the project schedule and 45-day outlook played an integral role. Among other things, the Project Team used the schedule to maintain the critical path and to ensure the proper levels of inspection and testing were provided in the right places and at the right times. The schedule also proved useful in quantifying delays and identifying remedies.

Weekly meeting minutes were published and used as a tool to track change orders and schedule changes, and to ensure that all outstanding issues were resolved in a timely manner. A centralized pay item tracking system allowed all changes to be tracked and reported on a monthly basis. E-mail was aggressively used to quickly manage change orders. Cell phones, digital cameras, and a GPS survey system enhanced this process, allowing the construction team to consult electronically with the design team and project management team.

The Project Team wrote press releases in advance of all road closures and significant lane closures, and published a weekly newsletter for local businesses so they could keep employees and customers aware of impending traffic changes. A Web site was developed with varying levels of security allowing interested parties to view all project documents within their secured clearance range.

The local press was very helpful in keeping the public informed of impending changes. This was particularly important for emergency service providers and trucking companies whose routes were restricted by the low clearance bridges on the project. To expedite construction, the City took an unprecedented step. Historically, street closures required City Council approval, a process that can take up to a month. For this project, the Project Team was given the authority to close streets on their own initiative, while considering the impact on the public and the unique authority granted. Because of the success of this process, the City intends to use it again on future major projects.

SAFETY

The combination of heavy train traffic, heavy street congestion, heavy construction equipment, elevated work zones, hazardous construction operations, and curious onlookers, all within a very confining work zone, created a potentially dangerous environment in and around the project site. Pile driving and other specialty work such as CWR construction presented their own unique hazards. Safety was a top priority and had to be considered every step of the way. All construction workers received special training in railroad safety procedures.

Daily safety meetings for construction workers were conducted, plus special safety briefings in advance of each new operation, all in two languages. Detailed contingency plans were prepared for any accidents occurring atop the partially completed elevated structure where no ambulance access was possible. Thorough investigations, reports, and corrective measures followed each incident.

In addition to managing vehicles passing through the project, there were massive material deliveries on city streets such as 8,900 precast concrete retaining wall units and 50,000 semi-truck loads of granular fill material.

The bridge girders were delivered by rail, but had to be offloaded from the streets by cranes so massive as to require full four-lane street closures. Special haul routes were designated for safety and logistics purposes. Traffic safety was enhanced by thorough planning, press releases in advance of each major traffic change, and accident investigations, reports, and corrective measures. Emergency service providers were notified in advance of street closures and traffic shifts. Compliance with all of these procedures was monitored in weekly meetings with published meeting minutes.

Crane lifting girder into place.

The railroads were important partners in the project safety program. UPRR and BNSF provided experienced flaggers who protected workers and trains alike, often coordinating construction operations with train movements. They attended and contributed to the safety meetings and provided extra sets of eyes watching for unauthorized persons on the project and impending safety issues.

ENVIRONMENTAL CONSIDERATIONS

The Project Team was cognizant of environmental impacts throughout the duration of the project. The grade separation structures were designed and constructed with features that reused existing materials, minimized the project footprint, incorporated locally available building materials, reduced water and energy consumption, reduced noise, minimized storm water impacts during construction, reduced vehicle emissions, and aesthetically improved downtown Wichita.

The project included removal of 16 miles of existing railroad tracks and ties, and the suitable rail was used in construction of the industry tracks. The remaining ballast has salvage value, but transport off-site can sometimes trigger environmental regulatory requirements because of the potential for leakage of diesel fuels and other chemicals that can occur over years of use. The Contractor salvaged the existing ballast and TranSystems' developed testing procedures to classify it into various categories for use on the project. Some of it was used in new track construction and some was used to stabilize the granular fill in advance of asphalt paving. TranSystems went on to develop testing procedures to verify proper application and compaction of these materials. The asphalt sub-ballast incorporated reclaimed materials, and much of the foundation stabilization was accomplished using reclaimed concrete.

In addition to being unsightly and in some ways hazardous, the old rail corridor was very noisy. It became even noisier when pile driving commenced, so the project team timed and monitored the operation to minimize its impacts. Significant noise reduction has been accomplished by elevating the tracks, incorporating CWR that eliminates the "clacking" sound of conventional jointed rail, and constructing parapet walls on both sides of the tracks. There are also sound absorbing qualities in the layered aspects of CWR on wood ties on stone ballast on asphalt sub-ballast on reclaimed railroad ballast on granular fill material. Also, by eliminating at-grade street crossings, the need for blaring train whistles has been greatly reduced.

The project was not only environmentally conscience, but also complied with all state and local environmental requirements. For instance, TranSystems acquired the typical storm water permits associated with a project of this magnitude, and continually monitored the Contractor's compliance with the Storm Water Pollution Prevention Plan during construction. During the environmental scan, it was determined that groundwater beneath the project had been contaminated by nearby industrial operations. The project was designed to minimize intrusions into the water table for the purposes of safety and environmental protection.

During construction, soil contamination was discovered on the project in two instances. The Project Team arranged subcontracting to licensed firms for the waste characterization, excavation, clearance testing, transport, and disposal of these materials, and wrote the necessary change orders. The sites were monitored to prevent exposure of untrained and unprotected workers to the contaminated materials.

The resulting structures allow traffic to pass beneath the tracks eliminating 4.2 million hours per year of waiting on trains, the equivalent of seven lifetimes. In addition, the reduced idling saves 3.8 million gallons of fuel per year, also reducing vehicle emissions.

LESSONS LEARNED

The benefits of the construction sequencing plan have been discussed, but there are hidden dangers as well. During construction, track stability and clearances cannot be compromised; nor can construction safety procedures or daily operating schedules be infringed upon. The same can be said with respect to maintenance of street traffic. Those involved in the planning process must be highly experienced in these areas for the project to be constructed safely and efficiently.

Construction delays were caused by Hurricanes Katrina and Rita, the Greensburg tornado, and regional flooding in southeastern Kansas that caused shortages in labor, equipment, and materials. For example, there was new and overriding demand for railroad ballast that had been destined for the project, but was diverted for emergency track repairs. These shortages were overcome by the Project Team using a number of strategies. The use of a unit price contract and expedited change order procedures allowed rapid response and just compensation for the needed changes. The AFE's provided compensation to the railroads on a time and materials basis, allowing flexibility in decision-making. Computerized critical path scheduling allowed reprioritization of tasks so that, even in times of shortage, crews could be reassigned to locations and tasks where materials and equipment were available. The interchangeable unit design of the precast concrete retaining wall system, along with the nearby fabrication and staging yard, resulted in the just-in-time delivery needed to accommodate rapid fire schedule changes.

The main tracks carried extremely valuable, and sometimes potentially hazardous cargo. Tracks were monitored before, during, and after pile driving. The use of satellite/GPS monitoring of the retaining walls and foundation system, along with instant electronic communications, provided assurances to all parties of the stability of the new structure before, during and after Class 1 rail loading.

There were many stakeholders on the project and many have their own construction specifications, safety procedures, material acceptance procedures, cost accounting procedures, submittal review procedures, reporting hierarchy and scheduling constraints. This stew had many cooks, and there were new technologies employed on the project with which some were unfamiliar. Prior to construction, it was necessary to outline which construction specifications would be most applicable to each construction operation. The reporting and payment process had to accommodate the various accounting, reporting and approval systems. Given the complexity of the project, it was impossible to completely define all of these processes. Advanced planning and constant communication among the stakeholders was necessary throughout the project, to prevent surprises and their resulting delays. Commitment and flexibility from all project partners was essential.

CONCLUSIONS

New bridge crossing

For the first time in 100 years, street traffic and emergency vehicles crossed beneath the tracks on three arterial thoroughfares without being stopped by trains. The reduction in traffic congestion lessens the number of accidents that had once been a major issue for the City of Wichita. On a larger scale, this improvement removed a major obstacle to economic development in downtown Wichita, sparking new growth that will benefit the entire city. The community was highly supportive of the work. Many citizens commented that they didn’t realize construction was ongoing due to the lack of disruption to the traveling public. They recognized the project when the trains were on the elevated structure and the motoring public was no longer stopped by a crossing train.

People across the nation envision such improvements in their own cities and communities. In addition to the cost, the sheer complexity of the task often appears insurmountable. This award winning project serves as a model, and sets the standard by which similar projects can and should be successfully accomplished. In fact, because of the success demonstrated by this project, other areas of Wichita and other cities within the state of Kansas are implementing the same grade separation concept to solve similar issues. The project demonstrates the value of looking beyond basic engineering design and construction issues, and incorporating financial responsibility, environmental responsibility, railroad requirements, local business needs, aesthetics, convenience to the motoring public, and safety into the design. It also demonstrates the effectiveness of partnering with all the stakeholders and using creative contracting mechanisms to accomplish the project goals.

In a letter to the Secretary of the Kansas Department of Transportation, Dave Burk, Developer and President of the Wichita Old Town Association wrote, “Old Town has greatly benefitted from the Wichita Central Corridor Railroad Grade Separation project. Travel to the destination has become more convenient and efficient, and the area once plagued with noise pollution from passing trains is now graced with the music coming from surrounding businesses and people interacting as they pass one another in the streets. The improvement removed a major obstacle to economic development in downtown Wichita, sparking new growth that will not only benefit Old Town, but the entire City, and we are proud to have been a part of it.”

According to Chris Carrier, PE, Director of Public Works, “TranSystems led the way with construction management and took ownership in bringing this project to fruition. Even though TranSystems dealt with two Class I railroads, funding from multiple sources, tight working conditions, and natural disasters, their engineers produced construction documents and provided administration services that met and exceeded the City’s expectations, while improving the quality of life for our citizens. Not only did their management techniques bring order to this dynamically responsible project using recycled materials and locally available construction materials, but they were able to minimize the project footprint.”

AKNOWLEDGEMENTS

City of Wichita, Public Works Department, sponsored the project and supported it with funding and engineering expertise.

TranSystems served as Program Manager on behalf of the City, providing stakeholder coordination, contract development, design, construction contract administration, inspection and testing services.

HNTB served as designer-of-record.

UPRR provided a portion of the funding and railroad flagging services, and constructed Chisolm Creek Bridge and a portion of the track per union rules.

BNSF provided railroad flagging services and ballast delivery, and connected the main track built on the project to their active main tracks per union rules.

Dondlinger & Sons Construction Company, Inc. served as general contractor, coordinating the work of more than 20 local subcontractors and suppliers for the project:

Geotechnologies and Peterson Construction designed and constructed the ground improvement.

Trac-Work built the Temporary Main Track, both main tracks, and industry tracks.

Neel Company designed the proprietary T-WALL® Retaining Wall System.

Wichita Concrete Pipe fabricated 7,800 precast concrete T-WALL® units and 1,132 parapets.

Wildcat Construction assembled the T-WALL® segments to build the 25-ft. retaining walls.

American Bridge fabricated the structural steel bridge girders.

Cornejo Construction constructed the 6-inch asphalt sub-ballast and other paving.

Whitewing Construction constructed sidewalks and the moment slab.

Thomas Industrial Coatings supplied the paint and painted the bridges.

Atlas Electric provided the lighting on the bridges.

Terracon provided laboratory services.

Cillessen & Sons provided traffic control during the lowering of the streets.

Green Glo and Stan’s Sprinklers supplied the creative landscaping solutions.

American Fence provided decorative and security fencing.

Garber provided surveying services.

Lafarge provided state certified concrete batching and delivery.

Other funding sources and supporters: KDOT, FHWA, FRA, Congressman Todd Tiahrt, Wichita business owners and commuters

Wichita Media Outlets:

KCTU

ABC-KAKE TV 10

CBS-KWCH TV 12

NBC – KSN TV 3

FOX – KSAS TV 24

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